

Prince George Ambient Air Monitoring Program

1998 Air Quality Data Summary

INTRODUCTION

The 1998 Prince George Air Quality Data Summary summarizes the data of the joint government/industry program to monitor reduced sulphur (TRS), sulphur dioxide (SO_2), nitrogen oxides (NO_x), particulate less than ten microns (PM_{10}), particulate less than two and half microns ($\text{PM}_{2.5}$), carbon monoxide (CO), and ground level ozone (O_3) in Prince George.

In June 1998 a new monitoring station was located in Hart Highlands at Glenview School near the intersection of East Austin Road and Highway 97 North. The new station is comprised of a TRS analyzer and a continuous particulate PM_{10} sampler (a TEOM from BC Environment) with the maintenance costs shared between industry and the Ministry. This is an opportunity for the Ministry to monitor air quality in this location for which dispersion modelling has shown significant pulp mill contributions of fine particulates. It is also the most populated area of the City not included within the current air quality monitoring network, and it is a growing area with potential for varied development.

Interpretation of the data is not provided in this summary report but will be available in the final Annual Air Quality Report. Anyone wishing further information on the data in this summary or on the monitoring network should contact one of the people listed at the bottom of this page.

CONCLUSIONS

- a) The total reduced sulphur (TRS) Provincial Level A one-hour objective ($7\mu\text{g}/\text{m}^3$) was exceeded a maximum of 17.9% of time, at the Jail station, and a minimum of 2.6% at the Lakewood station. TRS levels in the Prince George area in 1998 exceeded the Provincial Level B one hour objective ($28\mu\text{g}/\text{m}^3$) from 0% of the time at the Lakewood station to 0.7% of the time at the Jail station. The Plaza and Jail stations recorded similar averages to the early 1990's.
- b) The CBC Transmitter station recorded the highest average annual SO_2 concentration of $22.6\mu\text{g}/\text{m}^3$ in 1998. The three other monitoring sites, Downtown-Plaza 400, College Heights Gladstone Elementary and the Jail site, recorded annual averages of $11.9\mu\text{g}/\text{m}^3$, $7.9\mu\text{g}/\text{m}^3$ and $18.6\mu\text{g}/\text{m}^3$, respectively. The CBC station recorded the most exceedances of the Level A one-hour objective (10) and the highest one-hour average concentration ($597\mu\text{g}/\text{m}^3$). The Jail site recorded only one exceedance of the Level A one-hour objective, and no exceedances were recorded at Plaza or Gladstone.
- c) Of the six PM_{10} non-continuous monitoring stations, Lakewood recorded the lowest annual average. The BCR site recorded the greatest number of exceedances of the Level B daily criteria ($50\mu\text{g}/\text{m}^3$) by continuous and non-continuous monitoring. The CNR site recorded the highest annual average of $34.0\mu\text{g}/\text{m}^3$ and the station at Hart Highlands recorded the highest daily average of $144\mu\text{g}/\text{m}^3$.

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1.0 TOTAL REDUCED SULPHUR (TRS) RESULTS

TRS describes a group of sulphur compounds containing gases made up primarily of four compounds; dimethyl disulphide (DMS), dimethyl sulphide (DMS), methyl mercaptan (MESH), and hydrogen sulphide (H_2S).

These compounds are largely by-products of the pulping process, that is, these compounds are not added directly but form because of the use of other sulphides in the pulping process. Pulp mills using the kraft process emit the largest amounts of TRS (in Prince George) followed by oil and gas processing plants (refining) and to a small extent automobiles (catalytic converters). Natural sources include swamps, bogs, and marshes.

Tables 1.1 to 1.5 list monthly summaries of TRS concentrations for each of the Prince George TRS ambient air stations and their respective annual summary for 1998.

Table 1.1
1998 Monthly Summary of TRS Data at Jail

	Monthly Average ($\mu g/m^3$)	No. of 1-Hour Values		Maximum Hourly Average ($\mu g/m^3$)	No. of Daily Values		Maximum 24 Hour Average ($\mu g/m^3$)
		$>7\mu g/m^3$	$>28\mu g/m^3$		$>3\mu g/m^3$	$>6\mu g/m^3$	
January	4.4	202	0	26	16	9	13.4
February	5.0	223	2	30	19	12	14.4
March	2.8	117	2	30	11	5	15.0
April	2.2	87	1	41	9	1	7.8
May	1.8	74	2	33	9	2	8.8
June	2.3	82	6	51	9	3	18.7
July	2.7	91	4	45	10	5	10.0
August	1.6	58	2	43	4	2	12.5
September	2.7	106	5	35	11	3	9.3
October	6.1	226	31	43	16	12	26.1
November	2.8	113	0	23	13	3	12.3
December	2.9	109	2	30	11	5	15.2
Annual	3.1	1488	57	51	138	62	26.1

B.C. Ambient Air Quality Objectives
Total Reduced Sulphur (TRS)

Level A

Level B

One Hour Average

$7 \mu g/m^3$

$28 \mu g/m^3$

24 Hour Average

$3 \mu g/m^3$

$6 \mu g/m^3$

Table 1.2
1997 Monthly Summary of TRS Data at Plaza

	Monthly Average ($\mu\text{g}/\text{m}^3$)	No. of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. of Daily Values		Maximum 24 Hour Average ($\mu\text{g}/\text{m}^3$)
		$>7\mu\text{g}/\text{m}^3$	$>28\mu\text{g}/\text{m}^3$		$>3\mu\text{g}/\text{m}^3$	$>6\mu\text{g}/\text{m}^3$	
January	4.6	197	0	27	16	9	14.5
February	3.7	146	0	21	16	6	10.6
March	2.0	57	1	31	7	1	8.9
April	1.8	37	0	20	3	0	5.9
May	0.9	31	0	27	2	0	4.3
June	1.0	30	1	38	3	1	7.8
July	1.5	47	1	28	5	0	8.1
August	0.7	13	0	13	1	0	6.1
September	2.1	85	0	23	8	3	10.9
October	3.0	130	0	26	10	5	16.0
November	2.5	90	0	27	10	3	10.3
December	2.6	95	6	50	7	4	19.5
Annual	2.2	958	9	50	88	32	19.5

Table 1.3
1998 Monthly Summary of TRS Data at Lakewood

	Monthly Average ($\mu\text{g}/\text{m}^3$)	No. of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. of Daily Values		Maximum 24 Hour Average ($\mu\text{g}/\text{m}^3$)
		$>7\mu\text{g}/\text{m}^3$	$>28\mu\text{g}/\text{m}^3$		$>3\mu\text{g}/\text{m}^3$	$>6\mu\text{g}/\text{m}^3$	
January	2.1	86	0	18	8	3	10.7
February	1.1	28	0	14	3	0	5.9
March	0.2	0	0	6	0	0	1.9
April	0.2	4	0	11	0	0	2.3
May	0.2	2	0	10	0	0	1.5
June	0.3	2	0	9	0	0	1.3
July	0.3	4	0	11	0	0	2.2
August	0.2	1	0	7	0	0	1.0
September	0.3	5	0	10	0	0	2.5
October	1.3	47	0	17	5	2	7.6
November	1.0	17	0	10	2	0	5.7
December	0.9	19	0	18	3	0	4.5
Annual	0.7	215	0	18	21	5	10.7

Table 1.4
1998 Monthly Summary of TRS Data at Hart Highlands - East Austin

	Monthly Average ($\mu\text{g}/\text{m}^3$)	No. of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. of Daily Values		Maximum 24 Hour Average ($\mu\text{g}/\text{m}^3$)
		$>7\mu\text{g}/\text{m}^3$	$>28\mu\text{g}/\text{m}^3$		$>3\mu\text{g}/\text{m}^3$	$>6\mu\text{g}/\text{m}^3$	
January	0.6	1	0	13	0	0	1.9
February	0.3	0	0	4	0	0	1.1
March	0.1	0	0	6	0	0	1.0
Annual	0.4	1	0	13	0	0	1.9

Table 1.5
1998 Monthly Summary of TRS Data at Hart Highlands - Glenview

	Monthly Average ($\mu\text{g}/\text{m}^3$)	No. of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. of Daily Values		Maximum 24 Hour Average ($\mu\text{g}/\text{m}^3$)
		$>7\mu\text{g}/\text{m}^3$	$>28\mu\text{g}/\text{m}^3$		$>3\mu\text{g}/\text{m}^3$	$>6\mu\text{g}/\text{m}^3$	
June	0.1	0	0	3	0	0	0.6
July	0.1	2	0	13	0	0	1.3
August	0.2	2	0	7	0	0	1.1
September	0.3	2	0	18	0	0	2.3
October	0.5	1	0	9	0	0	1.8
November	0.3	3	0	11	0	0	2.8
December	0.2	4	0	10	0	0	2.7
Annual	0.3	14	0	18	0	0	2.8

Monthly averages ranged from a high of $6.1 \mu\text{g}/\text{m}^3$ at Jail (October) to a low of $0.1 \mu\text{g}/\text{m}^3$ at the Hart Highlands - Glenview and East Austin (July and March, respectively). Jail had the highest annual average followed by Plaza and then Lakewood. Both Hart Highlands sites were not included as only a partial year of monitoring is available.

1.1 TRS Annual Trends

The TRS data from the Plaza (1980-1998), the Jail (1981-1998), and Lakewood (1982-1998) stations were examined to reveal trends in Prince George. The following tables (Table 1.6 - Table 1.8) summarize the TRS data from the three stations over the last sixteen to eighteen years.

A major improvement in TRS levels have occurred from 1988 to 1990. Since 1990 TRS levels have declined slightly from year to year. The annual average concentrations for Plaza and Jail are the lowest since the monitoring program started. The trend in 1996 and 1997 at the Plaza and Jail stations had been a decrease of approximately 70% over the 1986-1989 averages but in 1998 the trend at these two sites shows an increase over the previous two years.

Table 1.6
Annual Trend Summary of TRS Data at Jail

Year	Annual Average ($\mu\text{g}/\text{m}^3$)	No. (%) of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. (%) of Daily Values		Maximum Daily Average ($\mu\text{g}/\text{m}^3$)	No. of hours Instrument Operated
		$>7\mu\text{g}/\text{m}^3$	$>28\mu\text{g}/\text{m}^3$		$>3\mu\text{g}/\text{m}^3$	$>6\mu\text{g}/\text{m}^3$		
1981	7.2	1673 (21.7%)	638 (8.3%)	177	151 (47.0%)	121 (37.7%)	59.6	7701
1982	8.8	1169 (23.8%)	519 (10.6%)	149	125 (61.0%)	99 (48.3%)	53.5	4915
1983	11.0	2051 (27.3%)	1066 (14.2%)	156	184 (58.8%)	151 (48.2%)	70.2	7511
1984	6.5	1341 (17.6%)	593 (7.8%)	170	136 (42.8%)	109 (34.3%)	54.8	7638
1985	6.4	1483 (19.1%)	546 (7.0%)	149	145 (44.8%)	117 (36.1%)	44.9	7773
1986	9.8	2404 (29.1%)	1028 (12.4%)	347	197 (57.1%)	169 (49.0%)	68.0	8268
1987	11.6	2268 (29.0%)	1306 (16.7%)	382	200 (54.8%)	175 (47.9%)	86.0	7817
1988	11.6	2307 (27.9%)	1343 (16.2%)	312	197 (53.8%)	166 (45.4%)	94.6	8267
1989	9.2	1852 (25.8%)	793 (11.0%)	212	174 (47.7%)	134 (36.7%)	68.3	7183
1990	5.4	927 (14.3%)	215 (3.3%)	177	91 (24.9%)	66 (18.1%)	46.7	6494
1991	3.1	1195 (14.4%)	138 (1.7%)	126	117 (32.1%)	61 (16.7%)	39.2	8316
1992	3.7	1103 (14.9%)	71 (1.0%)	78	109 (29.9%)	66 (18.1%)	17.7	7387
1993	3.8	1343 (16.7%)	201 (2.5%)	69	123 (33.7%)	86 (23.6%)	37.7	8061
1994	3.1	1214 (15.1%)	108 (1.3%)	57	119 (32.6%)	67 (18.4%)	19.7	8017
1995	3.3	1274 (15.2%)	73 (0.9%)	64	157 (43.0%)	64 (17.5%)	23.0	8359
1996	2.6	1043 (12.5%)	42 (0.5%)	62	112 (30.7%)	53 (14.5%)	18.8	8359
1997	2.5	1157 (13.9%)	42 (0.5%)	55	119 (32.6%)	37 (10.1%)	21.3	8347
1998	3.1	1488 (17.9%)	57 (0.7%)	51	138 (37.8%)	62 (17.0%)	26.1	8314

Table 1.7
Annual Trend Summary of TRS Data at Plaza

Year	Annual Average ($\mu\text{g}/\text{m}^3$)	No. (%) of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. (%) of Daily Values		Maximum Daily Average ($\mu\text{g}/\text{m}^3$)	No. of hours Instrument Operated
		$>7\mu\text{g}/\text{m}^3$	$>28\mu\text{g}/\text{m}^3$		$>3\mu\text{g}/\text{m}^3$	$>6\mu\text{g}/\text{m}^3$		
1980	5.9	1085 (16.0%)	449 (6.6%)	163	127 (45.0%)	85 (30.1%)	62.4	6772
1981	6.0	1276 (16.9%)	566 (7.5%)	241	136 (43.2%)	101 (32.1%)	53.8	7558
1982	5.3	1241 (15.1%)	445 (5.4%)	198	156 (45.5%)	111 (32.4%)	41.3	8235
1983	8.6	1670 (20.7%)	817 (10.1%)	177	180 (53.4%)	150 (44.5%)	90.5	8082
1984	4.7	978 (11.9%)	372 (4.5%)	227	121 (35.2%)	84 (24.4%)	51.7	8246
1985	4.8	875 (12.3%)	406 (5.7%)	297	106 (35.8%)	78 (26.4%)	81.6	7115
1986	7.9	1295 (20.1%)	677 (10.5%)	289	126 (46.8%)	102 (37.9%)	61.4	6456
1987	9.0	1806 (21.8%)	972 (11.7%)	218	174 (47.7%)	143 (39.2%)	69.0	8280
1988	7.3	1633 (19.7%)	792 (9.5%)	194	159 (43.4%)	121 (33.1%)	69.4	8297
1989	5.9	1376 (16.9%)	594 (7.3%)	184	140 (38.4%)	111 (30.4%)	41.8	8166
1990	2.7	905 (11.0%)	187 (2.3%)	122	100 (27.4%)	57 (15.6%)	47.0	8234
1991	2.2	925 (11.2%)	43 (0.5%)	58	84 (23.0%)	46 (12.6%)	19.4	8256
1992	2.1	882 (10.6%)	34 (0.4%)	69	89 (24.4%)	49 (13.4%)	18.4	8300
1993	2.4	956 (11.4%)	92 (1.1%)	72	89 (24.4%)	54 (14.8%)	29.8	8360
1994	1.9	790 (9.5%)	22 (0.3%)	67	84 (23.0%)	34 (9.3%)	19.1	8295
1995	1.9	757 (9.2%)	20 (0.2%)	44	93 (25.5%)	32 (8.8%)	20.5	8205
1996	1.8	592 (8.3%)	28 (0.4%)	103	67 (18.4%)	25 (6.8%)	27.2	7168
1997	1.6	654 (7.8%)	13 (0.2%)	40	65 (17.8%)	22 (6.0%)	12.9	8371
1998	2.2	958 (11.6%)	9 (0.1%)	50	88 (24.1%)	32 (8.8%)	19.5	8245

Table 1.8
Annual Trend Summary of TRS Data at Lakewood

Year	Annual Average ($\mu\text{g}/\text{m}^3$)	No. (%) of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. (%) of Daily Values		Maximum Daily Average ($\mu\text{g}/\text{m}^3$)	No. of hours Instrument Operated
		$>7\mu\text{g}/\text{m}^3$	$>28\mu\text{g}/\text{m}^3$		$>3\mu\text{g}/\text{m}^3$	$>6\mu\text{g}/\text{m}^3$		
1982*	0.9	176 (3.0%)	22 (0.4%)	85	22 (9.1%)	13 (5.4%)	19.7	5785
1983	2.6	615 (7.9%)	147 (1.9%)	99	79 (24.5%)	43 (13.4%)	40.7	7737
1984	0.9	199 (2.4%)	15 (0.2%)	64	34 (9.9%)	10 (2.9%)	15.4	8269
1985	1.0	216 (2.9%)	28 (0.4%)	50	29 (9.3%)	12 (3.9%)	21.6	7456
1986	1.7	439 (5.6%)	110 (1.4%)	71	51 (15.7%)	32 (9.9%)	27.1	7807
1987	1.6	461 (6.0%)	106 (1.4%)	92	51 (14.0%)	34 (9.3%)	35.7	7680
1988	1.1	270 (3.6%)	38 (0.5%)	64	38 (10.4%)	23 (6.3%)	17.5	7462
1989	0.7	170 (2.8%)	33 (0.5%)	92	22 (6.0%)	8 (2.2%)	28.0	6057
1990	0.3	66 (1.2%)	3 (0.05%)	79	8 (2.2%)	1 (0.3%)	10.5	5484
1991	0.6	173 (2.3%)	3 (0.04%)	37	19 (5.2%)	4 (1.1%)	18.7	7667
1992	0.6	214 (2.6%)	0 (0.00%)	27	22 (6.0%)	9 (2.5%)	11.7	8351
1993	0.9	308 (4.4%)	6 (0.09%)	86	32 (8.8%)	13 (3.6%)	19.4	6952
1994	0.6	147 (1.8%)	2 (0.02%)	74	21 (5.8%)	4 (1.1%)	11.5	8196
1995	0.9	270 (3.2%)	2 (0.02%)	37	37 (10.1%)	11 (3.0%)	15.0	8358
1996	0.7	227 (2.7%)	8 (0.1%)	44	27 (7.4%)	7 (1.9%)	15.0	8281
1997	0.7	174 (2.1%)	0 (0.0%)	27	17 (4.7%)	4 (1.1%)	9.8	8211
1998	0.7	215 (2.6%)	0 (0.0%)	18	21 (5.6%)	5 (1.3%)	10.7	8204

* Instrument Operated June - December 1982

2.0 SULPHUR DIOXIDE (SO₂) RESULTS

Sulphur dioxide is formed primarily by the combustion of material containing sulphur. It is a colourless gas and at concentrations above 900 µg/m³ (Hourly Level B objective) has a pungent odour. At present, major sources of SO₂ in the Prince George area include the Husky refinery and the pulp mills.

The sulphur dioxide (SO₂) data are summarized in Tables 2.1- 2.5. The average annual ambient SO₂ levels were within the Provincial objectives at all stations. Only the CBC transmitter site recorded more than one Level A hourly exceedance and one daily exceedance in 1998. This station also recorded the highest one-hour average concentration (597 µg/m³). Both Plaza and Gladstone did not record any exceedances of the Provincial objectives.

Table 2.1
1998 Monthly Summary of SO₂ Data at Jail

	Monthly Average (µg/m ³)	No. of 1-Hour Values		Maximum Hourly Average (µg/m ³)	No. of Daily Values		Maximum 24 Hour Average (µg/m ³)
		>450µg/m ³	>900µg/m ³		>160µg/m ³	>260µg/m ³	
January	27.8	0	0	264	0	0	119.4
February	28.8	0	0	413	0	0	106.1
March	18.0	0	0	253	0	0	112.7
April	12.7	0	0	226	0	0	54.9
May	12.3	0	0	301	0	0	56.0
June	-	-	-	-	-	-	-
July	23.9	1	0	469	0	0	107.6
August	15.5	0	0	426	0	0	129.0
September	17.6	0	0	301	0	0	79.6
October	15.7	0	0	205	0	0	80.1
November	14.5	0	0	226	0	0	76.3
December	18.4	0	0	301	0	0	91.0
Annual	18.6	1	0	469	0	0	129.0

B.C. Ambient Air Quality Objectives
Sulphur Dioxide (SO₂)

Level A

Level B

One Hour Average
24 Hour Average
Annual Average

450 µg/m³
160 µg/m³
25 µg/m³

900 µg/m³
260 µg/m³
50 µg/m³

Table 2.2
1998 Monthly Summary of SO₂ Data at Plaza

	Monthly Average ($\mu\text{g}/\text{m}^3$)	No. of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. of Daily Values		Maximum 24 Hour Average ($\mu\text{g}/\text{m}^3$)
		>450 $\mu\text{g}/\text{m}^3$	>900 $\mu\text{g}/\text{m}^3$		>160 $\mu\text{g}/\text{m}^3$	>260 $\mu\text{g}/\text{m}^3$	
January	22.8	0	0	237	0	0	93.5
February	20.9	0	0	399	0	0	80.7
March	8.6	0	0	221	0	0	44.8
April	7.1	0	0	264	0	0	38.0
May	9.2	0	0	152	0	0	36.1
June	7.8	0	0	221	0	0	37.4
July	10.4	0	0	192	0	0	51.2
August	9.3	0	0	218	0	0	62.1
September	12.0	0	0	280	0	0	57.4
October	14.2	0	0	237	0	0	73.0
November	11.9	0	0	218	0	0	74.5
December	9.9	0	0	216	0	0	75.4
Annual	11.9	0	0	399	0	0	93.5

Table 2.3
1998 Monthly Summary of SO₂ Data at CBC Transmitter

	Monthly Average ($\mu\text{g}/\text{m}^3$)	No. of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. of Daily Values		Maximum 24 Hour Average ($\mu\text{g}/\text{m}^3$)
		>450 $\mu\text{g}/\text{m}^3$	>900 $\mu\text{g}/\text{m}^3$		>160 $\mu\text{g}/\text{m}^3$	>260 $\mu\text{g}/\text{m}^3$	
January	31.5	1	0	485	0	0	175.3
February	30.0	2	0	559	0	0	192.3
March	21.0	1	0	535	0	0	97.7
April	23.6	0	0	365	0	0	72.5
May	17.1	0	0	418	0	0	110.9
June	20.3	0	0	365	0	0	95.8
July	33.2	1	0	562	0	0	123.1
August	18.4	1	0	479	0	0	137.1
September	24.3	1	0	530	0	0	97.5
October	24.8	3	0	597	1	0	224.0
November	16.7	0	0	426	0	0	61.4
December	11.3	0	0	386	0	0	115.7
Annual	22.6	10	0	597	1	0	224.0

Table 2.4
1998 Monthly Summary of SO₂ Data at Gladstone School

	Monthly Average ($\mu\text{g}/\text{m}^3$)	No. of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. of Daily Values		Maximum 24 Hour Average ($\mu\text{g}/\text{m}^3$)
		>450 $\mu\text{g}/\text{m}^3$	>900 $\mu\text{g}/\text{m}^3$		>160 $\mu\text{g}/\text{m}^3$	>260 $\mu\text{g}/\text{m}^3$	
January	24.0	0	0	160	0	0	76.5
February	16.0	0	0	149	0	0	71.7
March	4.4	0	0	80	0	0	21.1
April	4.6	0	0	85	0	0	19.1
May	2.9	0	0	77	0	0	15.0
June	3.4	0	0	80	0	0	14.6
July	6.1	0	0	120	0	0	25.0
August	4.0	0	0	123	0	0	27.4
September	5.3	0	0	152	0	0	31.3
October	10.2	0	0	128	0	0	40.3
November	6.5	0	0	117	0	0	36.7
December	8.2	0	0	104	0	0	40.8
Annual	7.9	0	0	160	0	0	76.5

Table 2.5
1998 Monthly Summary of SO₂ Data at Hart Highlands - East Austin

	Monthly Average ($\mu\text{g}/\text{m}^3$)	No. of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. of Daily Values		Maximum 24 Hour Average ($\mu\text{g}/\text{m}^3$)
		>450 $\mu\text{g}/\text{m}^3$	>900 $\mu\text{g}/\text{m}^3$		>160 $\mu\text{g}/\text{m}^3$	>260 $\mu\text{g}/\text{m}^3$	
January	3.2	0	0	27	0	0	16.0
February	3.4	0	0	32	0	0	9.0
March	1.8	0	0	27	0	0	6.3
Annual	2.9	0	0	32	0	0	16.0

* instrument installed June 20, 1997, closed March 1998.

2.1 SO₂ Annual Trends

Table 2.6 summarizes the annual trend of SO₂ data collected at the Jail station. Prior to 1986, data was obtained from a Philips SO₂ continuous analyzer which was subject to interference from various TRS compounds resulting in erroneous data. In 1986 the Philips analyzer was replaced with a TECO analyzer utilizing newer technology. The SO₂ average for 1986 is based upon Philips data for Jan. - Feb. and TECO monitor data for Mar. - Dec. The lower annual averages after 1986 are attributable to the improved accuracy of data provided by the new monitor.

The trend in ambient SO₂ levels recorded at the Jail site from 1990 to 1996 had shown an increase. However, since 1996, SO₂ levels have been decreasing at this site. For the first time in the last four year, the annual concentration at the Jail site was less than 20 µg/m³.

Table 2.6
Annual Trend Summary of SO₂ Data at Jail

Year	Annual Average (µg/m ³)	No. of 1-Hour Values		Maximum Hourly Average (µg/m ³)	No. of Daily Values		Maximum Daily Average (µg/m ³)	No. of Hours Instrument Operated
		>450µg/m ³	>900µg/m ³		>160µg/m ³	>260µg/m ³		
1981	10.7	1	0	506	0	0	75.2	7,016
1982	25.5	1	0	719	0	0	161.4	6,535
1983	31.8	1	0	533	0	0	143.5	8,310
1984	22.9	6	1	1198	3	0	242.8	7,551
1985	21.0	0	0	399	0	0	119.3	7,860
1986*	16.9	4	0	538	0	0	152.5	8,278
1987	12.8	2	0	666	0	0	123.0	8,348
1988	13.8	8	0	586	1	0	173.8	8,412
1989	12.0	1	0	659	0	0	99.6	8,165
1990	5.5	0	0	283	0	0	56.7	6,719
1991	8.7	1	0	492	0	0	118.1	8,236
1992	12.1	1	0	450	0	0	104.0	8,363
1993	10.9	0	0	363	0	0	81.8	8,225
1994	12.5	1	0	469	0	0	123.0	8,162
1995	20.5	1	0	530	0	0	118.8	8,354
1996	23.7	10	0	735	2	0	189.8	8,368
1997	20.5	4	0	759	0	0	143.2	8,350
1998	18.6	1	0	469	0	0	129.0	7,580

* Philips analyzer was replaced with a TECO analyzer

Tables 2.7 to 2.9 summarizes the annual trend of SO₂ data collected at the Plaza, CBC and Gladstone sites, respectively. In 1998, some reduction in ambient levels of SO₂ has occurred at most stations, except the CBC transmitter site.

Table 2.7
Annual Trend Summary of SO₂ Data at Plaza

Year	Annual Average ($\mu\text{g}/\text{m}^3$)	No. of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. of Daily Values		Maximum Daily Average ($\mu\text{g}/\text{m}^3$)	No. of Hours Instrument Operated
		>450 $\mu\text{g}/\text{m}^3$	>900 $\mu\text{g}/\text{m}^3$		>160 $\mu\text{g}/\text{m}^3$	>260 $\mu\text{g}/\text{m}^3$		
1995	12.8	2	0	474	0	0	156.3	5,323*
1996	15.8	13	1	913	1	0	167.9	8,229
1997	14.6	8	0	663	0	0	118.3	8,363
1998	11.9	0	0	399	0	0	93.5	8,220

* Instrument installed May 1995

Table 2.8
Annual Trend Summary of SO₂ Data at CBC

Year	Annual Average ($\mu\text{g}/\text{m}^3$)	No. of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. of Daily Values		Maximum Daily Average ($\mu\text{g}/\text{m}^3$)	No. of Hours Instrument Operated
		>450 $\mu\text{g}/\text{m}^3$	>900 $\mu\text{g}/\text{m}^3$		>160 $\mu\text{g}/\text{m}^3$	>260 $\mu\text{g}/\text{m}^3$		
1995	17.8	4	0	597	0	0	101.1	5,096*
1996	23.9	10	0	794	4	0	189.3	8,370
1997	20.1	9	0	778	2	0	197.7	8,312
1998	22.6	10	0	597	1	0	224.0	8,361

* Instrument installed May 1995

Table 2.9
Annual Trend Summary of SO₂ Data at Gladstone

Year	Annual Average ($\mu\text{g}/\text{m}^3$)	No. of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. of Daily Values		Maximum Daily Average ($\mu\text{g}/\text{m}^3$)	No. of Hours Instrument Operated
		>450 $\mu\text{g}/\text{m}^3$	>900 $\mu\text{g}/\text{m}^3$		>160 $\mu\text{g}/\text{m}^3$	>260 $\mu\text{g}/\text{m}^3$		
1995	6.6	0	0	269	0	0	96.3	5,430*
1996	10.5	0	0	280	0	0	85.4	8,370
1997	10.5	0	0	314	0	0	148.5	8,351
1998	7.9	0	0	160	0	0	76.5	8,269

* Instrument installed May 1995

3.0 NITROGEN DIOXIDE (NO₂) RESULTS

Nitrogen dioxide is a reddish-brown gas with a pungent and irritating odour over 250 µg/m³. The NO₂ absorbs short wave blue light, leaving longer wavelengths that cause it to appear reddish-brown.

NO₂ is emitted as a primary pollutant (emitted directly from high temperature combustion sources) or a secondary pollutant (produce from the oxidation of nitric oxide). Nitric oxide is formed during high temperature combustion, primarily from motor vehicle exhausts and stationary combustion (such as industrial processes, waste incineration, and fuel combustion for heating homes and buildings). Emissions of nitric oxide are greater during winter months when there is an increase in the use of heating fuels and in the idling of cars.

The nitrogen dioxide data from the Plaza and Hart Highlands - East Austin sites are summarized in Tables 3.1 and 3.2 respectively. Ambient NO₂ levels were well within the Provincial objectives, with no Level A hourly or daily exceedances.

Table 3.1.
1998 Monthly Summary of NO₂ Data at Plaza

	Monthly Average (µg/m ³)	No. of 1-Hour Values		Maximum Hourly Average (µg/m ³)	No. Of Daily Values		Maximum 24 Hour Average (µg/m ³)
		>400µg/m ³	>1000µg/m ³		>200µg/m ³	>300µg/m ³	
January	37.9	0	0	107	0	0	64.9
February	40.4	0	0	99	0	0	62.1
March	33.0	0	0	113	0	0	63.6
April	31.7	0	0	92	0	0	52.9
May	18.7	0	0	94	0	0	43.7
June	15.9	0	0	77	0	0	35.8
July	20.8	0	0	105	0	0	51.3
August	24.7	0	0	77	0	0	42.0
September	31.1	0	0	111	0	0	66.8
October	34.7	0	0	143	0	0	67.1
November	31.0	0	0	84	0	0	58.0
December	25.7	0	0	73	0	0	51.4
Annual	28.7	0	0	143	0	0	67.1

Table 3.2.
1998 Monthly Summary of NO₂ Data at Hart Highlands - East Austin

	Monthly Average ($\mu\text{g}/\text{m}^3$)	No. of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. Of Daily Values		Maximum 24 Hour Average ($\mu\text{g}/\text{m}^3$)
		>400 $\mu\text{g}/\text{m}^3$	>1000 $\mu\text{g}/\text{m}^3$		>200 $\mu\text{g}/\text{m}^3$	>300 $\mu\text{g}/\text{m}^3$	
January	22.3	0	0	187	0	0	48.8
February	33.2	0	0	94	0	0	58.4
March	20.6	0	0	94	0	0	48.6
Annual	25.6	0	0	187	0	0	58.4

*Note: monitor started operation April 1997, closed March 1998

3.1 NO₂ Annual Trends

A trend discussion has not been available previously due to the shortage of data particularly in 1992 and 1995. Year to year variations in average NO₂ levels are minor. However, the annual average in 1998 was the highest NO₂ annual average to be recorded since monitoring began at this site.

Table 3.3
Annual Trend Summary of NO₂ Data at Plaza

Year	Annual Average ($\mu\text{g}/\text{m}^3$)	No. of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. of 24 Hour Values		Maximum Daily Average ($\mu\text{g}/\text{m}^3$)	No. of Hours Instrument Operated
		>400 $\mu\text{g}/\text{m}^3$	>1000 $\mu\text{g}/\text{m}^3$		>200 $\mu\text{g}/\text{m}^3$	>300 $\mu\text{g}/\text{m}^3$		
1992	22.5	0	0	61	0	0	97.0	4,825*
1993	25.4	0	0	149	0	0	83.3	8,072
1994	23.7	0	0	130	0	0	70.7	7,852
1995	26.3	0	0	101	0	0	61.5	4,957**
1996	25.9	0	0	151	0	0	84.6	7,787
1997	24.3	0	0	186	0	0	91.5	8,242
1998	28.7	0	0	143	0	0	67.1	8,051

* Note: NO₂ TECO Analyzer Installed in June 1992

** Note NO₂ TECO Operational Problems

B.C. Ambient Air Quality Objectives Level B
Nitrogen Dioxide (NO₂)

Level C

One Hour Average
24 Hour Average
Annual Average

400 $\mu\text{g}/\text{m}^3$
200 $\mu\text{g}/\text{m}^3$
60 $\mu\text{g}/\text{m}^3$

1000 $\mu\text{g}/\text{m}^3$
300 $\mu\text{g}/\text{m}^3$
100 $\mu\text{g}/\text{m}^3$

4.0 OZONE (O₃) RESULTS

Ground level ozone is produced when oxides of nitrogen (NO_x) react with volatile hydrocarbons in the presence of sun light. Ozone is termed a secondary pollutant because it is produced from a photochemical reaction involving primary pollutants (NO_x and volatile hydrocarbons).

Tables 4.1 summarizes the ozone data recorded at the Plaza station. The maximum one-hour level (156 µg/m³) was recorded on June 8, which would be expected since solar radiation is at its maximum during the summer months. The greatest number of exceedances of the one-hour objective occurred in May, which was one of the sunniest on record, approximately 38% above normal. Exceedances of the one-hour Level A objective are expected to occur between the months of March and September. Exceedances of the 24-hour Level A objective can occur during any month, as there is some debate whether this objective is below the background level for ozone.

Table 4.1
1998 Monthly Summary of O₃ Data for Plaza

	Monthly Average (µg/m ³)	No. of 1-Hour Values		Maximum Hourly Average (µg/m ³)	No. of Daily Values		Maximum 24 Hour Average (µg/m ³)
		>100µg/m ³	>160µg/m ³		>30µg/m ³	>50µg/m ³	
January	25.4	0	0	86	9	4	66.1
February	29.2	0	0	90	9	4	78.7
March	47.3	0	0	96	23	15	89.3
April	52.3	20	0	114	29	13	88.2
May	63.2	115	0	138	30	26	100.0
June	47.8	16	0	156	27	13	86.6
July	36.3	6	0	118	19	3	66.5
August	33.6	1	0	102	20	1	52.2
September	27.7	0	0	92	11	2	58.3
October	22.5	0	0	76	9	1	55.9
November	20.9	0	0	78	7	1	53.7
December	38.7	1	0	128	21	10	73.6
Annual	37.1	159	0	156	214	93	100.0

B.C. Ambient Air Quality Objectives
Ozone (O₃)

Level A

Level B

One Hour Average
24 Hour Average
Annual Average

100 µg/m³
30 µg/m³

160 µg/m³
50 µg/m³
30 µg/m³

4.1 O_3 Annual Trends

A trend discussion has not been available previously due to the shortage of data since installation occurred in 1995. Annual average O_3 level in 1998 was higher than the annual average of the previous two full years of data. In 1998, six more days with sunshine were recorded from March to September and 125 hours over the year than in 1997.

Table 4.2
Annual Trend Summary of O_3 Data at Plaza

Year	Annual Average ($\mu\text{g}/\text{m}^3$)	No. of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. of Daily Values		Maximum Daily Average ($\mu\text{g}/\text{m}^3$)	No. of Hours Instrument Operated
		>100 $\mu\text{g}/\text{m}^3$	>160 $\mu\text{g}/\text{m}^3$		>30 $\mu\text{g}/\text{m}^3$	>50 $\mu\text{g}/\text{m}^3$		
1995	30.3	28	0	112	108	29	75.2	5,548*
1996	35.2	21	0	120	202	83	88.3	8,290
1997	35.2	54	0	120	217	88	81.8	8,358
1998	37.2	159	0	156	214	93	100.0	8,284

* Note: O_3 API Analyzer installed in late April 1995

5.0 PARTICULATE MATTER (PM_{10}) RESULTS

Particulate matter refers to small particles ranging in size from 0.001 μm (micrometres) to 100 μm . Particles range in chemical composition, size, shape, and physical properties. Sources of particles are either natural sources such as pollen, dust from soil erosion, volcanoes or man-made sources such as soot, flyash and smoke. In Prince George sources of particulate are industries, wood waste burners, road dust, sawmills, motor vehicles, burning of fuels for heating, and some natural sources.

Larger particulate may cause a nuisance or irritation problem but smaller particulate (less than 10 μm) cause the greatest health effect because they are inhaled deep into the lung cavities. Particles in this size range usually come from man-made sources, internal combustion engines, industrial processes, burning, and road dust.

Particulate matter less than 10 micrometres (PM_{10}) is measured either non-continuously (once every sixth day when samplers are run for 24 hours at a time) (six locations in Prince George), or continuously, using a tapered element oscillating microbalance technology (TEOM).

Table 5.1 summarizes the PM_{10} data from both the continuous and non-continuous monitors in Prince George for 1998. Annual averages ranged from a low of 17.1 $\mu\text{g}/\text{m}^3$ at Gladstone to a maximum of 34.0 $\mu\text{g}/\text{m}^3$ at the CNR site. The maximum 24-hour average, 144 $\mu\text{g}/\text{m}^3$ was recorded at Hart.

Table 5.1
1998 Airshed Summary of PM₁₀

Station	Annual Average ($\mu\text{g}/\text{m}^3$)	No. (%) of Daily Values			Maximum Daily ($\mu\text{g}/\text{m}^3$)	Minimum Daily ($\mu\text{g}/\text{m}^3$)	No. of Values
		>50 $\mu\text{g}/\text{m}^3$	>100 $\mu\text{g}/\text{m}^3$	>150 $\mu\text{g}/\text{m}^3$			
Plaza	26.2	5 (8.2%)	1 (1.6%)	0	111	4	61
Plaza (TEOM)	22.7	20 (5.5%)	2 (0.5%)	0	114	3.0	363
Lakewood	19.6	1 (1.9%)	0	0	61	4	54
Van Bien	28.3	6 (10.9%)	0	0	91	5	55
CNR Site	34.0	8 (13.8%)	2 (3.4%)	0	124	5	58
BCR Site #2	31.7	10 (16.4%)	0	0	92	4	61
BCR Site #2 (TEOM)*	29.1	49 (13.5%)	4 (1.1%)	0	127	2.9	363
Gladstone	20.2	2 (3.3%)	0	0	57	< 2	61
Gladstone (TEOM)	17.2	7 (2.0%)	0	0	74	0.9	352
Hart-East Austin (TEOM)**	20.4	8 (10.0%)	3 (3.8%)	0	144	2.5	80
Hart-Glenview (TEOM)***	11.0	0	0	0	38	2.3	202

* instrument installed in late September 1996, ** instrument installed in early April 1997, removed March 1998

*** instrument installed in late June 1998

B.C. Ambient Air Quality Objectives for PM₁₀:..... Level B
24 Hour 50 $\mu\text{g}/\text{m}^3$

5.1 PM₁₀ Continuous Monitors

PM₁₀ is continuously sampled on top of the Plaza 400 building, Gladstone Elementary, Glenview School and the BCR Warehouse with a TEOM (tapered element oscillating microbalance) 1400a PM₁₀ sampler. The principle of operation is to draw a constant sample of air through a filter, continuously weighing the filter (every two seconds) and calculating real time (10 minute) mass concentrations. The instrument also calculates 30 minute, one hour, eight hour, and twenty-four hour averages of mass concentration. The initial weight of the filter is compared to the present weight to produce the total mass of the collected particulate.

The continuous PM₁₀ monitor at the Hart Highlands location was removed in March 1998 but re-established in June 1998 at Glenview School.

5.1.1 PM₁₀ Results

Tables 5.2 to 5.6 summarize the continuous PM₁₀ monitoring at the five monitoring sites in Prince George. Monthly concentrations ranged from 7.8 µg/m³ (at Glenview on December) to 49.1 µg/m³ (at BCR on March). The maximum hourly levels reached 582 µg/m³ at the BCR site whereas the maximum 24-hour level reached 144 µg/m³ at Hart Highlands.

Table 5.2
1998 Monthly Summary of Continuous PM₁₀ Data at Plaza

	Monthly Average (µg/m ³)	Maximum Hourly (µg/m ³)	No. of Daily Values		Maximum 24 Hour (µg/m ³)	Minimum 24 Hour (µg/m ³)
			>50µg/m ³	>100µg/m ³		
January	17.6	77	0	0	38	3.8
February	28.1	217	3	0	72	8.5
March	30.7	319	4	2	114	9.6
April	29.2	176	3	0	70	3.0
May	28.4	155	3	0	80	7.3
June	17.3	114	0	0	51	5.7
July	22.7	135	2	0	69	4.3
August	19.5	129	0	0	47	5.0
September	22.9	104	0	0	54	3.1
October	22.3	139	4	0	81	4.8
November	19.2	103	0	0	51	7.8
December	14.5	118	1	0	59	4.4
Annual	22.7	319	20	2	114	3.0

Table 5.3
1998 Monthly Summary of Continuous PM₁₀ Data at Gladstone

	Monthly Average (µg/m ³)	Maximum Hourly (µg/m ³)	No. of Daily Values		Maximum 24 Hour (µg/m ³)	Minimum 24 Hour (µg/m ³)
			>50µg/m ³	>100µg/m ³		
January	18.3	83	0	0	48	2.2
February	19.2	124	1	0	56	2.0
March	20.8	207	2	0	74	3.9
April	18.7	108	0	0	33	3.9
May	21.4	125	1	0	55	4.2
June	13.6	88	0	0	39	4.3
July	16.3	108	0	0	55	3.4
August	17.4	175	1	0	57	4.8
September	16.6	106	0	0	39	3.1
October	17.4	93	2	0	60	0.9
November	14.1	87	0	0	38	2.5
December	12.8	83	0	0	47	3.2
Annual	17.2	207	7	0	74	0.9

Table 5.4
1998 Monthly Summary of Continuous PM₁₀ Data at BCR

	Monthly Average ($\mu\text{g}/\text{m}^3$)	Maximum Hourly ($\mu\text{g}/\text{m}^3$)	No. of Daily Values		Maximum 24 Hour ($\mu\text{g}/\text{m}^3$)	Minimum 24 Hour ($\mu\text{g}/\text{m}^3$)
			>50 $\mu\text{g}/\text{m}^3$	>100 $\mu\text{g}/\text{m}^3$		
January	22.4	86	0	0	44	3.9
February	30.9	140	3	0	71	12.4
March	27.7	168	5	0	81	7.4
April	49.1	483	13	2	123	2.9
May	41.6	438	10	1	127	9.1
June	22.8	165	2	0	73	6.5
July	28.8	287	5	0	100	3.9
August	31.7	582	4	1	112	5.5
September	29.5	332	2	0	95	4.7
October	24.6	116	4	0	86	3.7
November	20.1	131	0	0	47	9.8
December	20.2	97	1	0	55	4.1
Annual	29.1	582	49	4	127	2.9

Table 5.5
1998 Monthly Summary of Continuous PM₁₀ Data at Hart Highlands -East Austin

	Monthly Average ($\mu\text{g}/\text{m}^3$)	Maximum Hourly ($\mu\text{g}/\text{m}^3$)	No. of Daily Values		Maximum 24 Hour ($\mu\text{g}/\text{m}^3$)	Minimum 24 Hour ($\mu\text{g}/\text{m}^3$)
			>50 $\mu\text{g}/\text{m}^3$	>100 $\mu\text{g}/\text{m}^3$		
January	11.0	53	0	0	31	2.5
February	20.3	323	3	0	82	4.7
March	33.9	567	5	3	144	4.5
Annual	20.4	567	8	3	144	2.5

Table 5.6
1998 Monthly Summary of Continuous PM₁₀ Data at Hart Highlands - Glenview

	Monthly Average ($\mu\text{g}/\text{m}^3$)	Maximum Hourly ($\mu\text{g}/\text{m}^3$)	No. of Daily Values		Maximum 24 Hour ($\mu\text{g}/\text{m}^3$)	Minimum 24 Hour ($\mu\text{g}/\text{m}^3$)
			>50 $\mu\text{g}/\text{m}^3$	>100 $\mu\text{g}/\text{m}^3$		
June	9.0	67	0	0	18	3.7
July	13.3	105	0	0	37	3.4
August	11.0	80	0	0	27	3.8
September	11.9	44	0	0	23	4.3
October	12.4	117	0	0	37	3.4
November	10.6	80	0	0	27	2.9
December	7.8	67	0	0	38	2.3
Annual	11.0	117	0	0	38	2.3

5.1.2 PM₁₀ Annual Trends (Continuous Monitors)

The continuous TEOM monitor showed a higher annual average PM₁₀ level in 1998 compared to the previous two years at the Plaza station as shown in Table 5.7. The TEOM monitor was sent for upgrades at the end of 1993. The annual average of the TEOM has usually been lower (1993 and 1994) than the discontinuous monitor and 1998 continued that trend with a difference of less than 3.5 µg/m³.

The TEOMs located at Gladstone School and the BC Rail Warehouse (Tables 5.8 and 5.9, respectively) have been operating since late December 1995 and October 1996, respectively, but have not operated long enough for any trend discussion. However, both sites did record higher annual averages in 1998 compared to the previous year.

Table 5.7
Annual Trend Summary of the Continuous PM₁₀ Data at Plaza

Year	Annual Average (µg/m ³)	Maximum Hourly Average (µg/m ³)	No. (%) of Days > 50 µg/m ³	No. (%) of Days > 100 µg/m ³	Maximum Daily Average (µg/m ³)	Hours Instrument Operated
1992	21.6	488	18 (6.1%)	0 (0%)	80	7,083
1993	22.3	171	11 (4.5%)	0 (0%)	75	5,828
1994*	22.3	284	19 (5.6%)	4 (1.2%)	117	8,162
1995	24.2	291	33 (9.1%)	2 (0.6%)	108	8,686
1996	20.5	373	10 (2.8%)	3 (0.8%)	152	8,567
1997	20.2	208	13 (3.6%)	0 (0%)	76	8,719
1998	22.7	319	20 (5.5%)	2 (0.5%)	114	8,719

* Monitor returned in January after upgrades

Table 5.8
Annual Trend Summary of the Continuous PM₁₀ Data at Gladstone

Year	Annual Average (µg/m ³)	Maximum Hourly Average (µg/m ³)	No. (%) of Days > 50 µg/m ³	No. (%) of Days > 100 µg/m ³	Maximum Daily Average (µg/m ³)	Hours Instrument Operated
1996	15.0	253	7 (1.9%)	1 (0.3%)	102	8,688
1997	14.8	155	7 (1.9%)	0 (0%)	61	8,673
1998	17.2	207	7 (1.9%)	0 (0%)	74	8,642

Table 5.9
Annual Trend Summary of the Continuous PM₁₀ Data at BCR

Year	Annual Average (µg/m ³)	Maximum Hourly Average (µg/m ³)	No. (%) of Days > 50 µg/m ³	No. (%) of Days > 100 µg/m ³	Maximum Daily Average (µg/m ³)	Hours Instrument Operated
1996*	21.3	125	5 (1.9%)	0 (0.3%)	69	2,257
1997	24.2	401	32 (8.9%)	2 (0.6%)	107	8,673
1998	29.1	582	49 (13.4%)	4 (1.1%)	127	8,702

* analyzer installed in October 1996

5.2 PM₁₀ Annual Trends (Non-continuous Monitors)

All stations showed higher annual averages in PM₁₀ levels in 1998 compared to the previous year. All stations except at Gladstone and Lakewood, recorded the lowest percentage of Level B exceedances. Annual average PM₁₀ levels at all sites in Prince George were the highest recorded since 1993, with the CNR and Van Bien sites recording the highest annual average ever recorded at those sites.

Tables 5.10 - 5.16 show the annual summary of PM₁₀ data from all the monitoring sites.

Table 5.10
Annual Trend Summary of Non-Continuous PM₁₀ Data at Plaza

Year	Annual Average (µg/m ³)	No. (%) of Daily Values > 50 µg/m ³	No. (%) of Daily Values > 100 µg/m ³	Maximum Daily Value (µg/m ³)	Number of Samples
1990	22.8	2 (7.7%)	0	90	26
1991	29.4	7 (11.7%)	1 (1.7%)	217	60
1992	28.6	6 (10.2%)	0	92	59
1993	30.2	10 (16.7%)	0	92	60
1994	24.1	6 (10.0%)	0	85	61
1995	23.6	4 (6.6%)	0	85	61
1996	21.9	2 (3.3%)	0	61	61
1997	20.8	1 (1.7%)	0	56	61
1998	26.9	5 (8.2%)	1 (1.6%)	111	61

Table 5.11
Annual Trend Summary of Non-Continuous PM₁₀ Data at Van Bien

Year	Annual Average ($\mu\text{g}/\text{m}^3$)	No. (%) of Daily Values > 50 $\mu\text{g}/\text{m}^3$	No. (%) of Daily Values > 100 $\mu\text{g}/\text{m}^3$	Maximum Daily Value ($\mu\text{g}/\text{m}^3$)	Number of Samples
1990	30.0	7 (26.9%)	0	62	26
1991	27.6	8 (13.6%)	0	84	59
1992	27.0	7 (12.5%)	0	89	56
1993	27.9	6 (10.2%)	0	99	59
1994	21.8	3 (6.3%)	0	69	48
1995	25.2	6 (10.2%)	1 (1.7%)	106	59
1996	23.4	3 (7.3%)	0	58	41
1997	20.8	3 (5.3%)	0	74	57
1998	28.3	6 (10.9%)	0	91	55

Table 5.12
Annual Trend Summary of Non-Continuous PM₁₀ Data at Lakewood

Year	Annual Average ($\mu\text{g}/\text{m}^3$)	No. (%) of Daily Values > 50 $\mu\text{g}/\text{m}^3$	No. (%) of Daily Values > 100 $\mu\text{g}/\text{m}^3$	Maximum Daily Value ($\mu\text{g}/\text{m}^3$)	Number of Samples
1990	17.4	0	0	40	24
1991	21.8	5 (8.5%)	0	89	59
1992	24.8	7 (11.9%)	0	74	59
1993	27.3	4 (7.6%)	1 (1.9%)	129	53
1994	18.9	1 (1.7%)	0	56	58
1995	18.7	4 (7.4%)	0	63	54
1996	16.3	0	0	50	59
1997	15.9	1 (1.7%)	0	51	59
1998	19.6	1 (1.9%)	0	61	54

* Note: High volume samplers converted to PM₁₀ (August 1, 1990). Therefore PM₁₀ data is for a 5 month duration.

Table 5.13
Annual Trend Summary of Non-Continuous PM₁₀ Data at the CNR Site

Year	Annual Average ($\mu\text{g}/\text{m}^3$)	No. (%) of Daily Values > 50 $\mu\text{g}/\text{m}^3$	No. (%) of Daily Values > 100 $\mu\text{g}/\text{m}^3$	Maximum Daily Value ($\mu\text{g}/\text{m}^3$)	Number of Samples
1991	30.9	5 (13.2%)	2 (5.3%)	124	38
1992	28.3	6 (10.3%)	1 (1.7%)	103	58
1993	33.3	14 (23.0%)	1 (1.6%)	104	61
1994	25.2	8 (13.6%)	0	75	59
1995	27.5	8 (13.3%)	1 (1.7%)	110	60
1996	28.1	5 (8.3%)	1 (1.7%)	110	60
1997	22.8	2 (3.6%)	0	65	55
1998	34.0	8 (13.8%)	2 (3.4%)	124	58

Table 5.14
Annual Trend Summary of Non-Continuous PM₁₀ Data at the BCR Site #1

Year	Annual Average ($\mu\text{g}/\text{m}^3$)	No. (%) of Daily Values > 50 $\mu\text{g}/\text{m}^3$	No. (%) of Daily Values > 100 $\mu\text{g}/\text{m}^3$	Maximum Daily Value ($\mu\text{g}/\text{m}^3$)	Number of Samples
1990	41.6	8 (21.6%)	3 (8.1%)	132	37
1991	49.3	8 (50.0%)	1 ((6.3%)	122	16
1992	31.3	2 (9.1%)	0	76	22
1993	43.2	17 (28.8%)	2 (3.4%)	147	59
1994	38.4	12 (21.1%)	2 (3.5%)	143	57
1995	40.9	16 (31.4%)	3 (5.9%)	181	51
1996	43.9	9(24.3%)	2 (5.4%)	153	37

* Note: Station relocated to CNR site May 6, 1991.

** Note: Monitoring started July 29, 1992.

***Note: Station closed August 20 1996 and relocated to BCR #2 site

Table 5.15
Annual Trend Summary of Non-Continuous PM₁₀ Data at the BCR Site #2

Year	Annual Average ($\mu\text{g}/\text{m}^3$)	No. (%) of Daily Values > 50 $\mu\text{g}/\text{m}^3$	No. (%) of Daily Values > 100 $\mu\text{g}/\text{m}^3$	Maximum Daily Value ($\mu\text{g}/\text{m}^3$)	Number of Samples
1996	31.8	4 (11.4%)	0	79	35
1997	26.0	4 (7.1%)	0	75	61
1998	31.7	10(16.4%)	0	92	61

* Note: Monitoring started June 2, 1996.

Table 5.16
Annual Trend Summary of Non-Continuous PM₁₀ Data at Gladstone

Year	Annual Average ($\mu\text{g}/\text{m}^3$)	No. (%) of Daily Values > 50 $\mu\text{g}/\text{m}^3$	No. (%) of Daily Values > 100 $\mu\text{g}/\text{m}^3$	Maximum Daily Value ($\mu\text{g}/\text{m}^3$)	Number of Samples
1992	19.5	1 (3.2%)	0	54	31
1993	25.8	5 (8.8%)	1 (1.8%)	122	57
1994	16.8	0	0	50	60
1995	16.7	2 (3.3%)	0	63	60
1996	15.4	0	0	49	59
1997	15.3	1 (1.7%)	0	57	61
1998	20.2	2 (3.3%)	0	57	61

* Note: Monitoring started June 5, 1992.

5.3 PM_{2.5} Results

The Ministry operates one continuous PM_{2.5} (particulate matter less than 2.5 micrometres) monitor, which is located at the Plaza site. The PM_{2.5} monitor operates in the same manner as the TEOM PM₁₀ monitors. The only difference is the head on this monitor allows only particles less than 2.5 µm to reach the filter.

Table 5.17
1998 Monthly Summary of Continuous PM_{2.5} Data at Plaza

	Monthly Average (µg/m ³)	Maximum Hourly (µg/m ³)	No. of Daily Values		Maximum 24 Hour (µg/m ³)	Minimum 24 Hour (µg/m ³)
			>25µg/m ³	>50µg/m ³		
January	14.7	63	2	0	35.0	3.7
February	15.0	61	2	0	29.0	3.1
March	11.9	61	0	0	27.3	4.6
April	11.5	72	0	0	23.6	2.3
May	13.0	62	2	0	32.3	4.8
June	10.4	109	2	0	36.9	2.3
July	13.2	98	3	0	50.8	2.8
August	11.1	57	1	0	27.6	3.5
September	13.0	68	1	0	32.3	2.5
October	16.2	126	4	1	56.7	3.7
November	13.8	52	2	0	27.3	5.8
December	10.3	88	3	0	44.2	3.2
Annual	12.8	109	22	1	56.7	2.3

5.4 PM_{2.5} Annual Trend (Non-continuous Monitor)

The Ministry operates one non-continuous PM_{2.5} monitor, which is located at the Plaza site. PM_{2.5} is measured by drawing air through a size selective inlet prior to collection on a teflon fibre filter at a rate of about 0.017 cubic metres per minute. The sampler is run for 24 hours at a time on a 6 day cycle (i.e., once every sixth day).

Table 5.18 shows the annual trend summary of PM_{2.5} data for the last five years at Plaza, which shows a steady decrease in levels.

Table 5.18
Annual Trend Summary of Non-Continuous PM_{2.5} Data at Plaza

Year	Annual Average (µg/m ³)	No. (%) of Daily Values > 25 µg/m ³	No. (%) of Daily Values > 50 µg/m ³	Maximum Daily Value (µg/m ³)	Number of Samples
1994*	13.5	1 (4.5%)	1 (4.5%)	52	22
1995	13.3	5 (8.8%)	1 (1.8%)	54	57
1996	12.7	4 (6.7%)	0	40	60
1997	12.3	6 (9.8%)	0	43	61
1998	11.4	5 (8.3%)	1 (1.7%)	52	60

* Instrument installed August 1994

6.0 Carbon Monoxide (CO)

Carbon monoxide is a colourless, odourless and tasteless gas. It is toxic at sufficiently high concentrations and death can result from asphyxiation. Hemoglobin in the blood has a greater affinity for CO, about 200 times more than oxygen, reducing the blood's ability to carry oxygen.

In an urban setting, CO levels are typically one hundred percent anthropogenic as a result of incomplete combustion of fossil fuels, notably the motor vehicle. CO is produced when the oxygen supply is reduced (fuel to oxygen ratio is too high) and when the temperature of combustion is lowered, slowing the oxidation process.

Table 6.1 shows the monthly summary of data at the Hart Highlands site. This site only operated for the first three months in 1998.

Table 6.1
1998 Monthly Summary of CO Data at Hart Highlands

	Monthly Average ($\mu\text{g}/\text{m}^3$)	No. of 1-Hour Values		Maximum Hourly Average ($\mu\text{g}/\text{m}^3$)	No. Of 8-Hour Values		Maximum 8-Hour Average ($\mu\text{g}/\text{m}^3$)
		>14300 $\mu\text{g}/\text{m}^3$	>28000 $\mu\text{g}/\text{m}^3$		>5500 $\mu\text{g}/\text{m}^3$	>11000 $\mu\text{g}/\text{m}^3$	
January	491.8	0	0	5800	0	0	3488
February	1042.6	0	0	7000	0	0	3338
March	143.2	0	0	3500	0	0	1750
Annual	589.1	0	0	7000	0	0	3488

B.C. Ambient Air Quality Objectives
Carbon Monoxide (CO)

One Hour Average
8 Hour Average

Level A

Level B

14300 $\mu\text{g}/\text{m}^3$ 28000 $\mu\text{g}/\text{m}^3$
5500 $\mu\text{g}/\text{m}^3$ 11000 $\mu\text{g}/\text{m}^3$

